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ABSTRACT

The purpose of this study was to determine if the use of Learning Logic, an integrated-learning system, by high school students in Algebra I had a significant effect on the performance of these students when they subsequently enrolled in a traditionally taught Algebra II course. Four high schools were selected in which Learning Logic was used for some Algebra I sections and in which other sections of Algebra I were taught without the use of Learning Logic. All such students who enrolled in Algebra II were included in the sample. Results of the analysis of Algebra II grades of these students revealed no significant differences between students who used Learning Logic in Algebra I and students who did not use Learning Logic in Algebra I. Teachers who used Learning Logic noted some benefits in terms of attitudes of students. (Author)

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Does the Use of Learning Logic in Algebra I Make a Difference in Algebra II?

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Abstract

The purpose of this study was to determine if the use of Learning Logic, an integrated-learning system, by high school students in Algebra I had a significant effect on the performance of these students when they subsequently enrolled in a traditionally-taught Algebra II course. Four high schools were selected in which Learning Logic was used for some Algebra I sections and in which other sections of Algebra I were taught without the use of Learning Logic. All such students who enrolled in Algebra II were included in the sample. Results of the analysis of Algebra II grades of these students revealed no significant differences between students who used Learning Logic in Algebra I and students who did not use Learning Logic in Algebra I. Teachers who used Learning Logic noted some benefits in terms of attitudes of students.

Microcomputers have been used in schools since the early 1980s. Yet Salerno (1995) states that the impact of computer technology on instructional effectiveness remains unknown. Recent studies have attempted to resolve this problem as it pertains to the mathematics classroom. For example, various mathematics software programs have been evaluated. Mayes (1995) reported that college algebra students who used the computer algebra system DERIVE performed significantly better in problem solving than students who were presented traditional algebra lectures. Yerushalmy and Gilead (1997) found that THE FUNCTION SUPPOSER was helpful to

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eighth graders who were solving equations. Cheung (1996) indicated that the algebra software MAPLE helped college students who were seeking teacher certification to understand mathematics concepts. Stephens and Konvalina (1999) reported that college algebra students who used MAPLE outperformed college algebra students who received lectures, and that their attitudes towards the use of MAPLE were favorable.

A related branch of research concerns the use of the integrated-learning system (ILS) in the mathematics classroom. Van Dusen and Worthen (1995) describe an ILS as software that is used on a file server, which is networked to a computer for each student in a computer lab environment. The lessons are automatically sent to each student's computer when the students log on. The lessons can be selected to individualize instruction for each student.

Learning Logic, an ILS, is an individualized, self-paced system. It covers the high school Algebra I curriculum, as well as portions of the Algebra II curriculum. Two doctoral dissertations and one educational specialist thesis have examined the effects of Learning Logic on mathematics learning and on attitudes toward mathematics. Lewis (1995) found that students who used Learning Logic in Algebra I enrolled in significantly more subsequent mathematics classes than did students who did not use Learning Logic in Algebra I. Wohlgehagen (1992) found attitude differences toward mathematics in favor of students who used Learning Logic as compared to those who did not use Learning Logic. Kintner (1995) reported a significant difference in mathematics achievement in favor of Algebra I students who used Learning Logic over students who did not use Learning Logic in Algebra I.

None of the three studies on Learning Logic focused on the effect Learning Logic has on mathematics achievement of students in subsequent classes. The purpose of the present study was

to determine the impact the use of Learning Logic in high school Algebra I has on grades of students when they enroll in Algebra II.

METHOD

The Learning Logic program is authored by the National Science Center Foundation, Incorporated. Learning Logic is an integrated-learning system that covers the high school Algebra I curriculum. Four high schools (three from Georgia and one from Louisiana) were chosen to participate in the study. In all four schools, some Algebra I classes were taught with the use of Learning Logic and some Algebra I classes were taught without the use of Learning Logic. A total of 133 students from these four schools used Learning Logic, and 95 students did not use Learning Logic. Algebra I students in all four high schools were randomly assigned to a Learning Logic classroom or to a traditional classroom. The same material was covered in all Algebra I classes. Of the total of 228 students, all enrolled later in Algebra II. All Algebra II classes were taught using traditional methods without the use of Learning Logic or other computer-assisted instruction.

Two independent variables were involved in the analysis. The first independent variable was school (Schools A, B, C, and D). The second independent variable was method of instruction for Algebra I (Learning Logic, traditional). Analyses were performed on two dependent variables. The first dependent variable was the numerical score students received as a final grade in Algebra I. The second dependent variable was the numerical score students received as a final grade in Algebra II. Because of possible variations in ability levels of students

in the four schools, eighth-grade mathematics scores from the Iowa Test of Basic Skills were used as a covariate. Therefore, separate 4(School) x 2(Algebra I method of instruction) analyses of covariance were performed, one for each dependent variable. For each dependent variable, the following null hypotheses were tested at the .05 significance level.

(1) There is no significant main effect on covariance-adjusted grades due to school.

(2) There is no significant main effect on covariance-adjusted grades due to method of instruction.

(3) There is no significant effect on covariance-adjusted grades due to the interaction between school and method of instruction.

RESULTS

Using Algebra I grades as the dependent variable, none of the three null hypotheses was rejected. That is, there was no significant difference among the covariance-adjusted Algebra I scores of the four schools ($F(3, 216) = 1.78, p > .05$). Similarly, there was no significant difference between the covariance-adjusted Algebra I scores of students who used Learning Logic and covariance-adjusted scores of students who did not use Learning Logic ($F(1, 216) = 0.12, p > .05$). No significant interaction between school and method of instruction was found ($F(3, 216) = 1.17, p > .05$). These results are summarized in Table 1.

Insert Table 1 about here.

As in the case when the Algebra I scores were analyzed, none of the three null hypotheses was rejected when Algebra II scores were used as the dependent variable. The main effect due to

school was not significant ($F(3, 216) = 2.12, p > .05$), nor were the main effect due to method of instruction ($F(1, 216) = 0.35, p > .05$) and the interaction ($F(3, 216) = 2.01, p > .05$). These results are summarized in Table 2.

Insert Table 2 about here.

DISCUSSION

The purpose of this study was to determine the impact that using Learning Logic to learn Algebra I has on subsequent grades in Algebra II when Algebra II is taught using conventional methods, without the use of computer-assisted instruction. Results of the analyses indicate that there is no significant difference between Algebra II grades of students who used Learning Logic in Algebra I and students who did not use Learning Logic in Algebra I. In the light of these results, one might ask why a school system should invest in an integrated-learning system such as Learning Logic. Several arguments can be made for such an investment.

First, it must be noted that the four school each randomly assigned approximately the same number of students to the Algebra I Learning Logic sections and the traditional Algebra I sections. Yet, 133 of the students who used Learning Logic went on to take Algebra II, whereas only 95 of the students who did not use Learning Logic enrolled in Algebra II. It could be conjectured that Learning Logic produced more positive attitudes towards mathematics. This may be for a variety of reasons, such as the fact that students were in control of the pace of their learning, and the teacher was able to provide more one-on-one assistance as students worked

problems.

A second potential reason is based on informal comments of the teachers who used Learning Logic. Teachers reported that fewer discipline problems existed in the Learning Logic classes, since students knew what they were to do from the minute they entered class until class was dismissed. Less time was spent on making transitions from one teaching/learning format to another. Principals concurred with this assessment.

A third reason is that, while no significant differences in Algebra II scores were found in favor of Learning Logic over traditional instruction, nor were there differences favoring traditional instruction over Learning Logic.

Caution should be exercised when interpreting these results. More than 70 high schools have used Learning Logic to teach Algebra I. Only four of these schools were involved in this study because of various reasons (the ITBS was not administered at some schools, letter grades rather than numerical grades were awarded at some schools, Learning Logic was used exclusively to teach Algebra I at some schools thus rendering no comparison groups, etc.). However, it appears that the potential benefits of using Learning Logic should provide a rationale for further research on such integrated-learning systems.

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Table 1. Analysis of covariance results for Algebra I.

Source	df	SS	MS	F	p
School	3	224.06	74.69	1.78	.15
Method	1	5.08	5.08	0.12	.73
ITBS	1	591.48	591.48	14.09	.0002
School x Method	3	147.70	49.23	1.17	.32
Residual	216	9065.89	41.97		

Table 2. Analysis of covariance results for Algebra II.

Source	df	SS	MS	F	p
School	3	659.16	219.72	2.12	.10
Method	1	35.78	35.78	0.35	.56
ITBS	1	1609.51	1609.51	15.52	.0001
School x Method	3	625.34	208.45	2.01	.11
Residual	216	22402.53	103.72		